

High Origin of the Superficial Palmar Branch of the Radial Artery Extending into the Princeps pollicis Artery

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The clinical applications of the radial artery depend on its “standard” anatomy. In the literature, however, there are many variations of the radial artery described, that may hamper clinical procedures. In this case report, we present some variations in the branching pattern of radial artery, found in the right upper limb of an embalmed male cadaver. The superficial palmar branch of the radial artery started from the radial artery at unusually high level - nearly 10 cm proximal to the wrist. The aberrant vessel passed just under the thenar muscle fascia and underneath the palmar aponeurosis it bifurcated into the princeps pollicis and radialis indicis arteries. Based on the presence of a small sized anastomosis at the level of the superficial palmar arch, it seemed that the main thumb arterial supply in this case depends on the variant superficial palmar branch of the radial artery of high origin.

Key words: radial artery, superficial palmar branch of the radial artery, princeps pollicis artery, arterial variations, upper limb

Introduction

The radial artery is a mid-sized vessel (external diameter about 3mm) [16] that follows the radial side of the anterior forearm, covered by the brachioradialis muscle [4, 7]. At the wrist, the radial artery sends a superficial branch to the superficial palmar arch from the ulnar artery and turning dorsally around the scaphoid and trapezium it passes through the muscles of the first interosseus (web) space. Here, the artery sends several branches to the palmar and dorsal sides of the thumb [4, 7]. The wrist portion of the radial artery is superficially located and with a proper diameter to provide a good vascular access site for interventional procedures [6, 21, 2]. The wide clinical application of the radial artery, either harvested as an arterial conduit for surgery or temporarily occluded for catheterization procedures, is based on the presumption that its anatomy is nearly corresponding to the classical textbook descriptions [4, 7] and most importantly – a good collateral system exists between the superficial and deep palmar arches [18, 22]. As a matter of fact, however, the radial artery system is variable in its antebrachial [10, 12, 22] and especially its distal parts [11, 16, 17], thus presenting a real danger of radial catheterization failure [24] or post-procedure thumb ischemia [13, 18, 23, 25].

Materials and Methods

The variations reported were observed during routine student dissections of the right upper limb of an adult formalin-fixed male cadaver of Caucasian descent. All dissections took place at the Department of Anatomy, Histology and Embryology, Medical University of Sofia.

Case report

The present case report describes variations in the branching pattern of radial artery in the distal third of the forearm, wrist and hand. The most noticeable finding was a large sized superficial palmar branch of the radial artery supplying the thumb. Upon dissecting the forearm vessels we noticed that the radial artery bifurcated nearly 10 cm above the distal wrist crease into two equal in size branches (**Fig. 1a; Fig. 2b**).

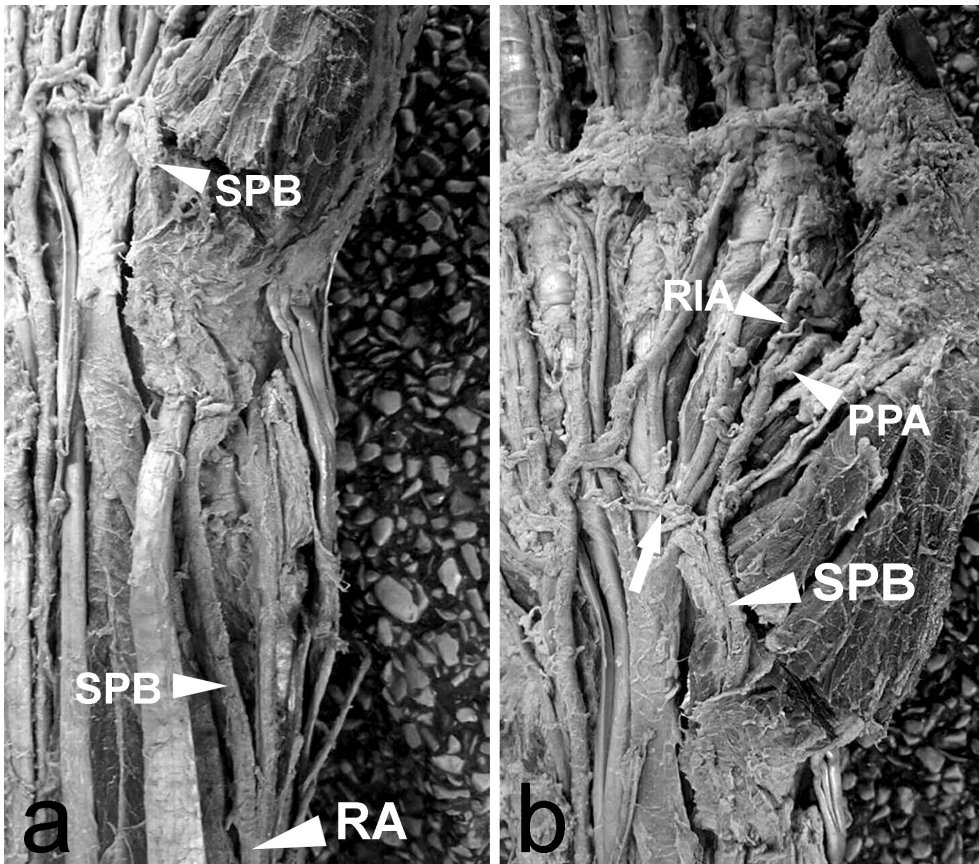


Fig. 1a, b. Anterior view of the forearm and wrist (a) and hand (b) demonstrating the variant branching pattern of the radial artery. Arteries: RA – radial artery; SPB – superficial palmar branch; PPA – princeps pollicis artery; RIA – radialis indicis artery. The white arrow indicates the small anastomosis between the superficial palmar branch of the radial artery and the distal ulnar artery within the superficial palmar arch.

The following dissection revealed that the medial one continued into the superficial palmar branch of the radial artery, while the lateral one extended into the distal part of the radial artery. The superficial palmar branch of the radial artery measured about 2.5 mm of external diameter and initially coursed parallel to the main radial artery, on its medial site, and lateral to the median nerve and flexor carpi radialis muscle. The superficial palmar branch crossed the thenar muscle tendons superficially and continued underneath the palmar aponeurosis. A dissection of this vessel showed that it bifurcated further into the princeps pollicis artery, providing radial and ulnar palmar arteries to the thumb and the radialisindicis artery (**Fig. 1b**; **Fig. 2b**). At the level of the origin of the flexor pollicis brevis muscle, the superficial palmar branch of the radial artery sent a small anastomosing branch (less than 1 mm in diameter) to the superficial palmar arch. The distal part of the usual radial artery had a normal course through the anatomical snuff box and first interosseous space without giving significant side branches. Entering the deep palmar region of the hand, the radial artery extended into the deep palmar arch that anastomosed at the end with a small deep palmar branch of the ulnar artery.

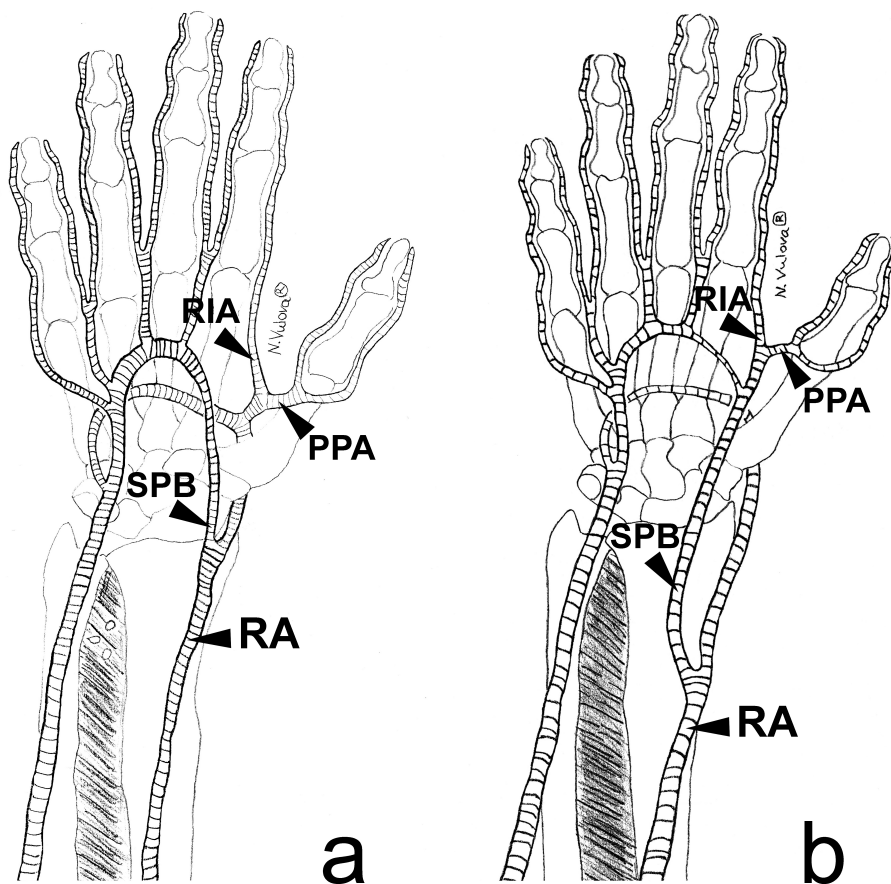


Fig. 2a, b. Schemes of the normal (a) and variant (b) branching pattern of the distal radial artery as described in our case. Arteries: RA – radial artery; SPB – superficial palmar branch; PPA – princeps pollicis artery; RIA – radialis indicis artery.

Discussion

In the case reported, there are variations of both antebrachial and distal parts of the radial artery, each one presenting distinctive clinical problems. Radial artery at the distal forearm and wrist is safe and effective vascular access site for the coronary and cerebrovascular interventional procedures [21]. This artery is preferred over brachial, axillary and femoral arteries for smaller size catheters based on its anatomical features [5, 8]. Moreover, the antebrachial portion of the radial artery is about 20 cm long and is considered an adequate auto-conduit for coronary system routinely harvested for coronary artery bypass graft surgery [1, 3]. Because of the high division of the radial artery, as reported here, at the typical wrist site instead of one large, two parallel smaller arteries were identified. Such a variant pattern has already been recognized as a potential problem for radial artery catheterization [12]. Moreover harvesting of such a bifurcated radial artery will not be desired for surgery.

Regarding the distal part of radial artery, the presence of a large sized superficial palmar branch providing mainly the blood supply of the thumb might be important in plastic and reconstructive surgery of the hand [20]. The presence of only small sized anastomosing branches between the distal parts of the radial and ulnar arteries, as reported in our case, might create a higher risk of thumb ischemia if radial artery is harvested for surgery or occluded by catheter. The higher origin of the superficial palmar branch of the radial artery has been reported previously [9], so is its branching into princeps pollicis and radialis indicis arteries [2, 14, 15, 19]. However, such a high origin of the superficial palmar branch of the radial artery providing mainly the thumb blood supply has not been described previously. In our dissection series, it was the only case in over 50 upper limbs dissected.

References

1. **Alameddine, A. K., V. K. Alimov, R. M. Engelman, J. A. Rousou, J. E. Flack, D. W. Deaton, D. T. Engelman.** Anatomic variations of the radial artery: significance when harvesting for coronary artery bypass grafting. – *J. Thorac. Cardiovasc. Surg.*, **127**, 2004, 1825-1827.
2. **Ames, E. L., M. Bissonnette, R. Acland, G. Lister, J. Firrell.** Arterial anatomy of the thumb. – *J. Hand Surg. Br.*, **18**, 1993, 427-436.
3. **Baikoussis, N. G., N. A. Papakonstantinou, E. Apostolakis.** Radial artery as graft for coronary artery bypass surgery: Advantages and disadvantages for its usage focused on structural and biological characteristics. – *J. Cardiol.*, **63**, 2014, 321-328.
4. **Bannister, L. H., M. Berry, P. Collins, M. Dyson, M. W. J. Ferguson** (Eds.). *Gray's Anatomy*, 38th Ed, Edinburgh, Churchill Livingstone, 1995, 1540-1544.
5. **Bianchi, R., L. D'Acerno, M. Crisci, D. Tartaglione, M. Cappelli Bigazzi, M. Canonico, M. Albanese, F. Gragnano, F. Fimiani, M. Russo, P. Cirillo, P. Calabrò.** From femoral to radial approach in coronary intervention angiology. – *Angiology*, **68**, 2017, 281-287.
6. **Chugh, S. K., Y. Chugh, S. Chugh.** How to tackle complications in radial procedures: Tip and tricks. – *Indian Heart J.*, **67**, 2015, 275-281.
7. **Clemente, C. D.** (Ed.). *Anatomy of the Human Body*, 30th Ed, Philadelphia, Lea and Febiger, 1985, 715-728.
8. **Franchi, E., P. Marino, G. G. Biondi-Zoccai, G. De Luca, C. Vassanelli, P. Agostoni.** Transradial versus transfemoral approach for percutaneous coronary procedures. – *Curr. Cardiol. Rep.*, **11**, 2009, 391-397.
9. **Gupta, C., B. Ray, A. S. Dsouza, N. Nair, S. R. Pai, M. Manju.** A morphological study of variations in the branching pattern and termination of the radial artery. – *Singapore Med. J.*, **53**, 2012, 208-211.
10. **Icten, N., Y. Sullu, I. Tuncer.** Variant high-origin radial artery: a bilateral case. – *Surg. Radiol. Anat.*, **18**, 1996, 63-66.

11. Ilić, M., M. Milisavljević, A. Maliković, D. Laketić, D. Erić, J. Boljanović, A. Dožić, B. V. Štimec, R. Manojlović. The superficial palmar branch of the radial artery: a corrosion cast study. – *Folia Morphol. (Warsz)*, **77**, 2018, 649-655.
12. Jelev, L., L. Surchev. Radial artery coursing behind the biceps brachii tendon: Significance for the transradial catheterization and a clinically oriented classification of the radial artery variations. – *CardioVasc. And Intervent. Radiol.*, **31**, 2008, 1008-1012.
13. Kleinert, J. M., S. G. Fleming, C. S. Abel, J. Firrell. Radial and ulnar artery dominance in normal digits. – *J. Hand Surg. Am.*, **14**, 1989, 504-508.
14. Loukas, M., S. Tubbs, R. G. Jr Louis, N. Apaydin. Princeps pollicis artery arising from the superficial palmar arch. – *Singapore Med. J.*, **50**, 2009, 391-392.
15. Madhyastha, S., B. V. Murlimanju, P. J. Jiji, V. V. Saralaya, A. Rai, R. Vadgaonkar. Morphological variants of the human superficial palmar arch and their clinical implications. – *J. Morphol. Sci.*, **28**, 2011, 261-264.
16. Nasr, A. The radial artery and its variations: Anatomical study and clinical implications. – *Folia Morphol.*, **71**, 2012, 252-262.
17. Ottone, N., N. Prum, M. Dominguez, E. Blasi, C. Medan, S. Shinzato, D. Finkelstein, V. Bertone. Analysis and clinical importance of superficial arterial palmar irrigation and its variants over 86 cases. – *Int. J. Morphol.*, **28**, 2010, 157-164.
18. Parks, B. J., J. Arbelaez, R. L. Horner. Medical and surgical importance of the arterial blood supply of the thumb. – *J. Hand Surg. Am.*, **3**, 1978, 383-385.
19. Ramirez, A. R., S. M. Gonzalez. Arteries of the thumb: Description of anatomical variations and review of the literature. – *PlasticReconstr. Surg.*, **29**, 2012, 468-476.
20. Rinker, B. Fingertip reconstruction with the laterally based thenar flap: Indications and long-term functional results. – *Hand (NY)*, **1**, 2006, 2-8.
21. Satti, S. R., A. Z. Vance, T. Sivapatham. Radial access for cerebrovascular procedures: Case report and technical note. – *Interv. Neuroradiol.*, **22**, 2016, 227-235.
22. Schussler, J. M. Effectiveness and safety of transradial artery access for cardiac catheterization. – *Proc. (Bayl. Univ. Med. Cent.)*, **24**, 2011, 205-209.
23. Türker, T., N. Capdarest-Arest. Acute hand ischemia after radial artery cannulation resulting in amputation. – *Chir. Main.*, **33**, 2014, 299-302.
24. Valsecchi, O., A. Vassileva, G. Musumeci, R. Rossini, M. Tespili, G. Guagliumi, L. Mihalcsik, A. Gavazzi, P. Ferrazzi. Failure of transradial approach during coronary interventions: anatomic considerations. – *Catheter Cardiovasc. Interv.*, **67**, 2006, 870-878.
25. Wilkins, R.G. Radial artery cannulation and ischaemic damage: A review. – *Anaesthesia*, **40**, 1985, 896-899.